



WELCOME TO NASA APPLIED REMOTE SENSING TRAINING (ARSET) WEBINAR SERIES

INTRODUCTION TO REMOTE SENSING FOR WILDFIRE APPLICATIONS

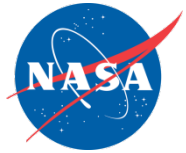
**COURSE DATES: EVERY TUESDAY, MARCH 31- APRIL 28
TIME: 11:30 AM-12:30 PM EST**



Important Information

- One lecture per week – every Tuesday from March 31 to April 28 (11:30 AM – 12:30 PM EST)
- Webinar recordings, PowerPoint presentations, and homework assignments can be found after each session at:
<http://arset.gsfc.nasa.gov/disasters/webinars/introduction-remote-sensing-wildfire-applications>
- Certificate of Completion
 - ▣ Attend 4 out of 5 webinars
 - ▣ Assignment 1 and 2 – access from the ARSET wildfire webinar website (above)
 - ▣ You will receive certificates approximately 1 month after the completion of the course from: marines.martins@ssaihq.com
- Q/A: 15 minutes following each lecture and/or by email (cynthia.l.schmidt@nasa.gov)

ARSET Wildfire Management



<http://arset.gsfc.nasa.gov/eco/webinars/land-management>



Registration: <https://arset.adobeconnect.com/wildfire/event/registration.html>

Agenda:  [NASA_ARSET_Wildfire_Webinar_Agenda.pdf](#)

Keywords: **Ecosystems, Fires and Smoke, Satellite Imagery, Vegetation Indices**

Instruments/Missions: **Landsat, MODIS, NPP, SMAP, VIIRS**

Presentations and Recordings

Week	Date	Title	Presentation	Recording	Assignment
1	March 31, 2015	Overview of remote sensing	 Week 1 Presentation  Week 1 Presentation (Spanish)	View Week 1 Recording	N/A
2	April 7, 2015	Satellite sensors and data products for wildfire applications	Week 2 Presentation Week 2 Presentation (Spanish)	View Week 2 Recording	Assignment 1
3	April 14, 2015	Remote sensing products for pre- and post-fire wildfire planning and assessment	Week 3 Presentation Week 3 Presentation (Spanish)	View Week 3 Recording	N/A



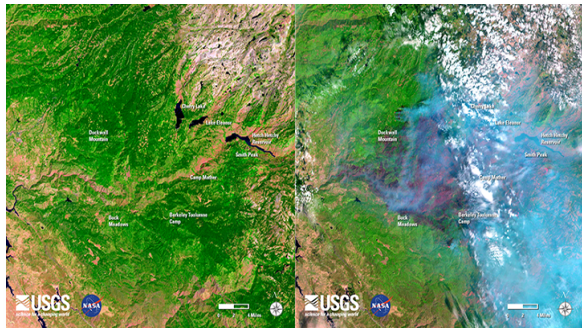
Your Course Instructors

- Cindy Schmidt (ARSET): cynthia.l.schmidt@nasa.gov
- Amber Kuss (ARSET): amberjean.m.kuss@nasa.gov
- Guest Speakers:
 - Tony Guay – USDA Forest Service Remote Sensing Applications Center (week 3)
 - Keith Weber – Idaho State University (week 3)
 - Dale Hamilton – Northwest Nazarene University (week 4)
 - Amita Mehta– NASA Goddard (week 4)
 - Lindsey Harriman and Kelly Lemig – LP DAAC (week 5)
lharriman@usgs.gov, klemig@usgs.gov

General inquiries about ARSET: Ana Prados (ARSET)
aprados@umbc.edu

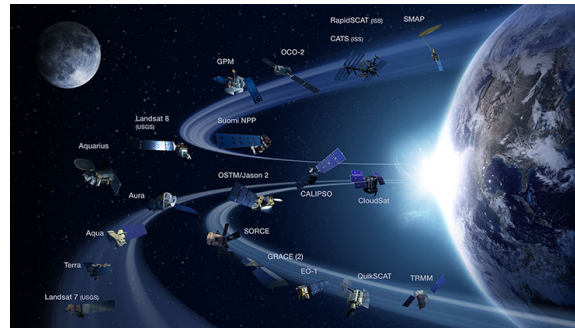
Course Outline

Week 1



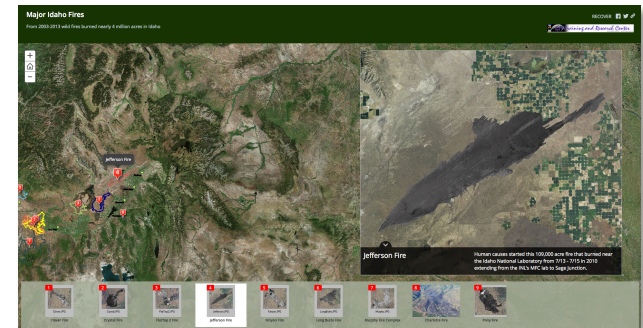
Overview of satellite remote sensing

Week 2



Platforms and sensors for wildfire applications

Week 3



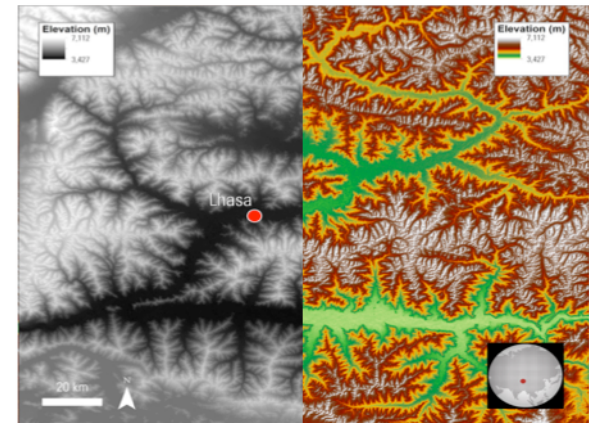
Products and tools for pre and post-wildfire

Week 4



New techniques and technologies

Week 5



Terrain data applications



Week 3 Agenda

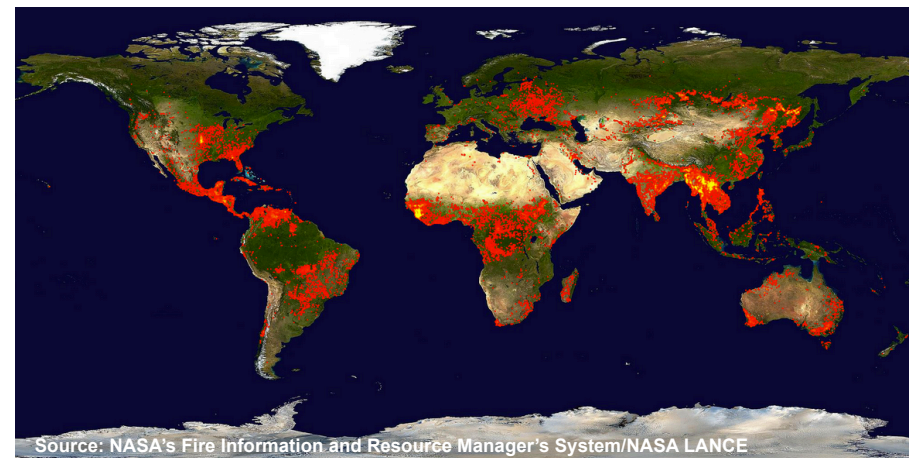
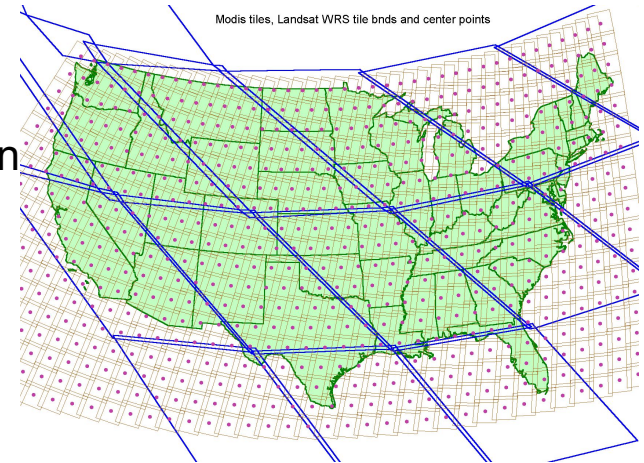
- ❑ Brief review of last week
- ❑ Guest Speaker: *Tony Guay, Remote Sensing Specialist* from the USDA Forest Service Remote Sensing Applications Center
 - ❑ Intensity and severity from field and satellite perspectives
 - ❑ Utilizing band combinations and indices for wildfire severity
 - ❑ Emergency response and post-fire classifications
- ❑ Guest Speaker: *Keith Weber, GIS Director* from Idaho State University
 - ❑ Overview of the NASA RECOVER Decision Support System (DSS)
 - ❑ RECOVER Live Demo



Review of Week 2

Week 2

- ❑ Data Processing Levels
 - ❑ Levels 1 and 2: highest spatial and temporal resolution
 - ❑ Levels 3 and 4: derived products, lower resolution
- ❑ Landsat Imagery Overview
 - ❑ Band overview and resolution
 - ❑ Where to obtain imagery
- ❑ MODIS Product Overview
 - ❑ Band overview and resolution
 - ❑ MODIS Products
 - Thermal Anomalies
 - Burned Area
- ❑ Wildfire Products and Tools
 - ❑ LANDFIRE
 - ❑ FRAMES
- ❑ Live Demos
 - ❑ FIRMS
 - ❑ Worldview





Guest Speaker: Tony Guay

Postfire Mapping Support in the USDA Forest Service: Normalized Burn Ratios & RSAC's BAER Imagery Support program



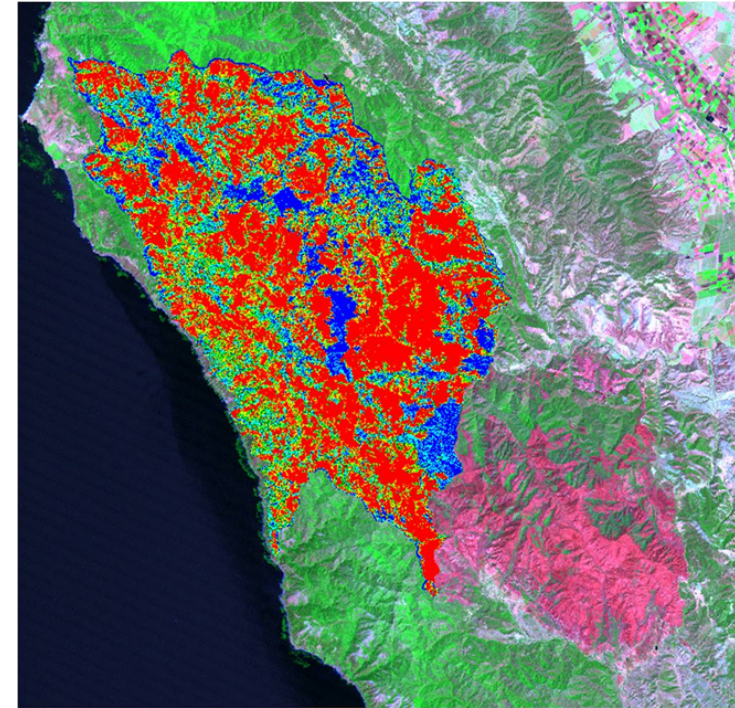
Tony Guay
Remote Sensing Specialist
Forest Service Contractor
Remote Sensing Applications Center (RSAC)

p: 801-975-3763
f: 801-975-3478
tguay@fs.fed.us

2222 West 2300 South
Salt Lake City, UT 84119
www.fs.fed.us



Caring for the land and serving people



USDA Forest Service, Remote Sensing Applications Center,
FSWeb: <http://fsweb.rsac.fs.fed.us>
WWW: <http://www.fs.fed.us/eng/rsac/>



Agenda

- Wildfire intensity & severity
- Soil burn severity vs. vegetation severity
- Field & satellite-based perspectives of soil burn severity
- Spectral reflectance of healthy vegetation vs. burned areas
- Optimal band combinations for viewing burned areas with satellite imagery
- Normalized Burn Ratios & dNBR for discriminating post-fire burn severity
- Remote sensing in support of Burn Area Emergency Response Teams
- Creating the Burned Area Reflectance Classification (BARC) for BAER Teams



Fire Intensity

- The amount of energy or heat release per unit time or area and encompasses several specific types of fire intensity measures.
- Byram (1959): “The rate of energy or heat release per unit time, per unit length of fire front, regardless of its depth.”



Byram, G.M. 1959. Combustion of forest fuels. In: Davis, K.P. (ed.). Forest fire: control and use. McGraw-Hill, New York. p. 61-89.

Fire (Burn) Severity

- The effect of a fire on ecosystem properties, often defined by the degree of mortality of vegetation.
 - Relates to soil heating, large fuel and duff consumption, consumption of the litter and organic layer beneath trees and isolated shrubs, and mortality of buried plant parts.
- Degree to which a site has been altered or disrupted by fire; loosely, a product of fire intensity and residence time.



Soil Burn Severity

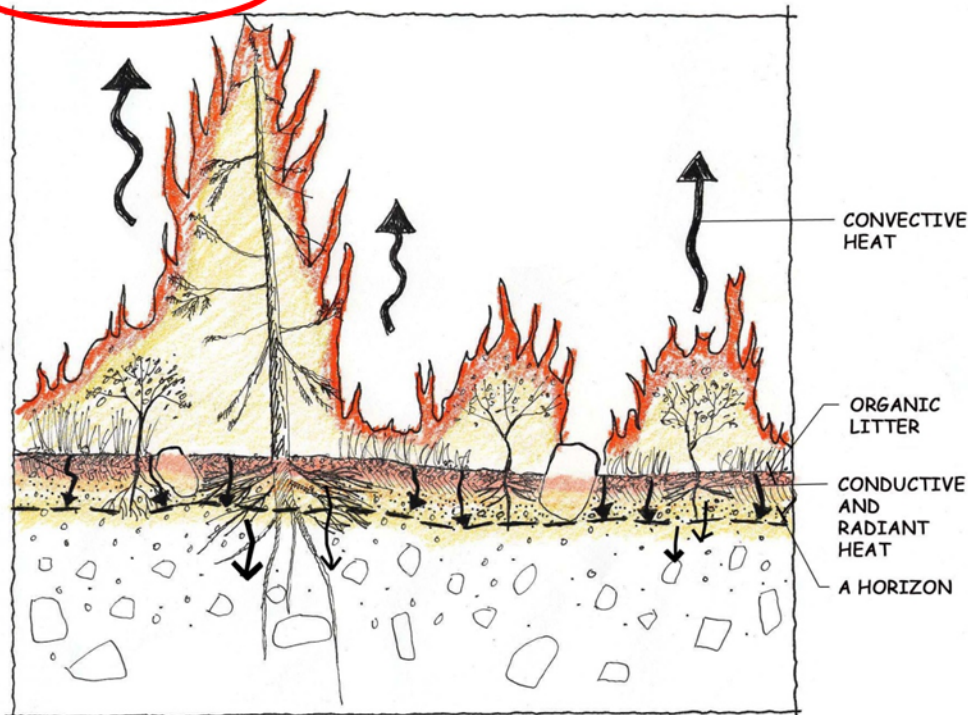
- The fire-induced changes in physical, chemical, and biological soil properties that impact hydrological and biological soil functions



Photo courtesy of Stefan Doe

Fire Intensity vs. Burn Severity

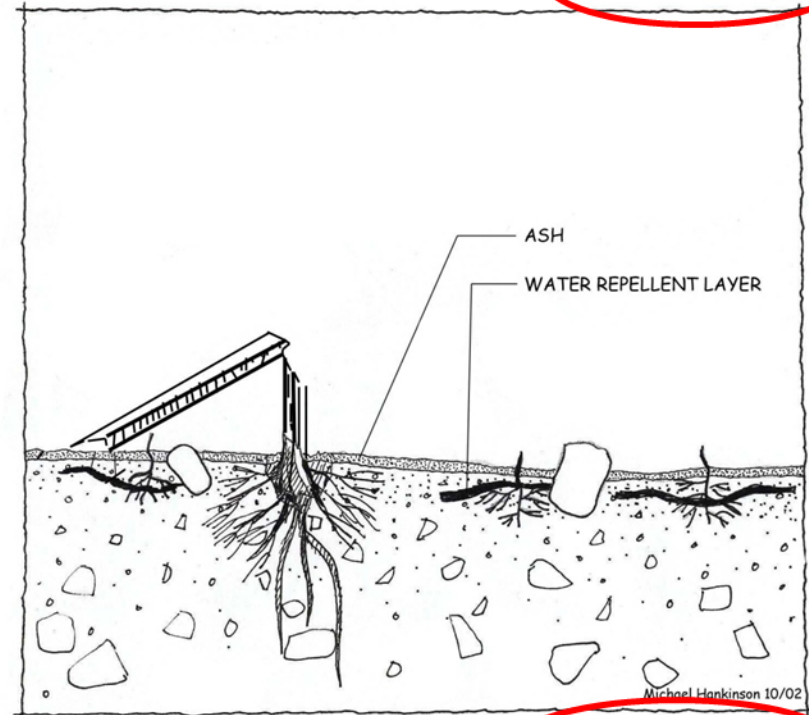
Fire Intensity



Soil Heating

During Fire

Burn Severity



Soil Burn Severity

After Fire

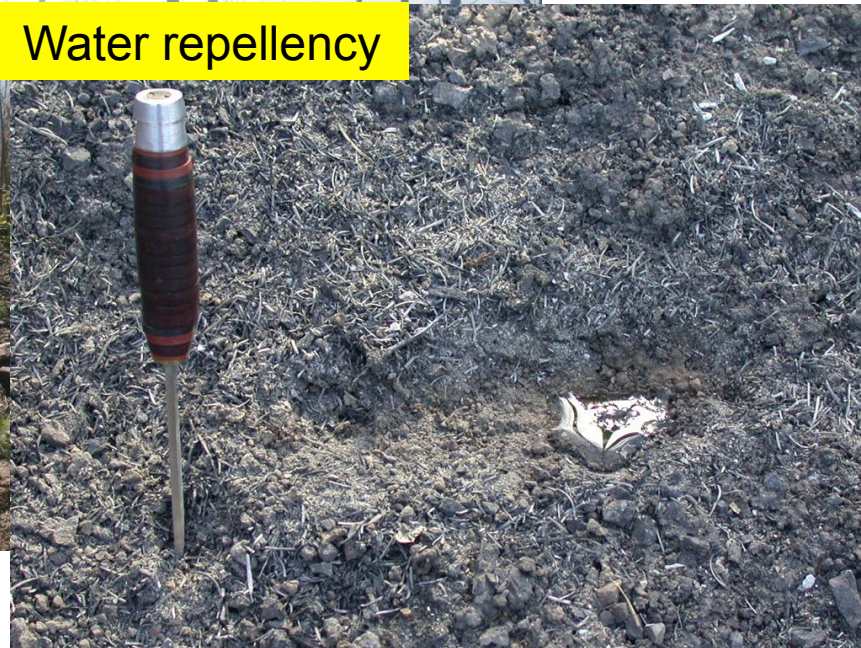
Field Perspective

- Ground-based severity assessments may include:
 - Composite Burn Index (CBI)
 - Hiking through and observing burned area mosaic
 - Water repellency tests

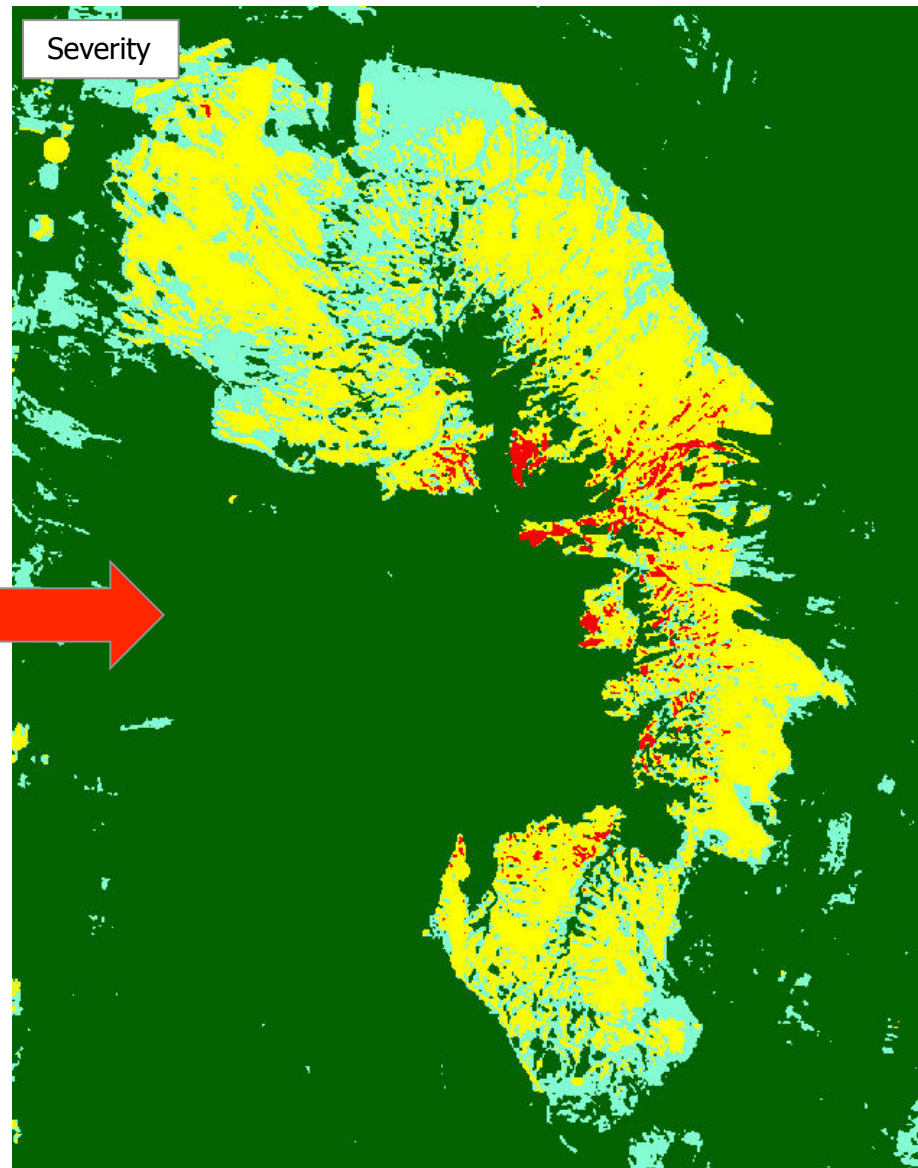
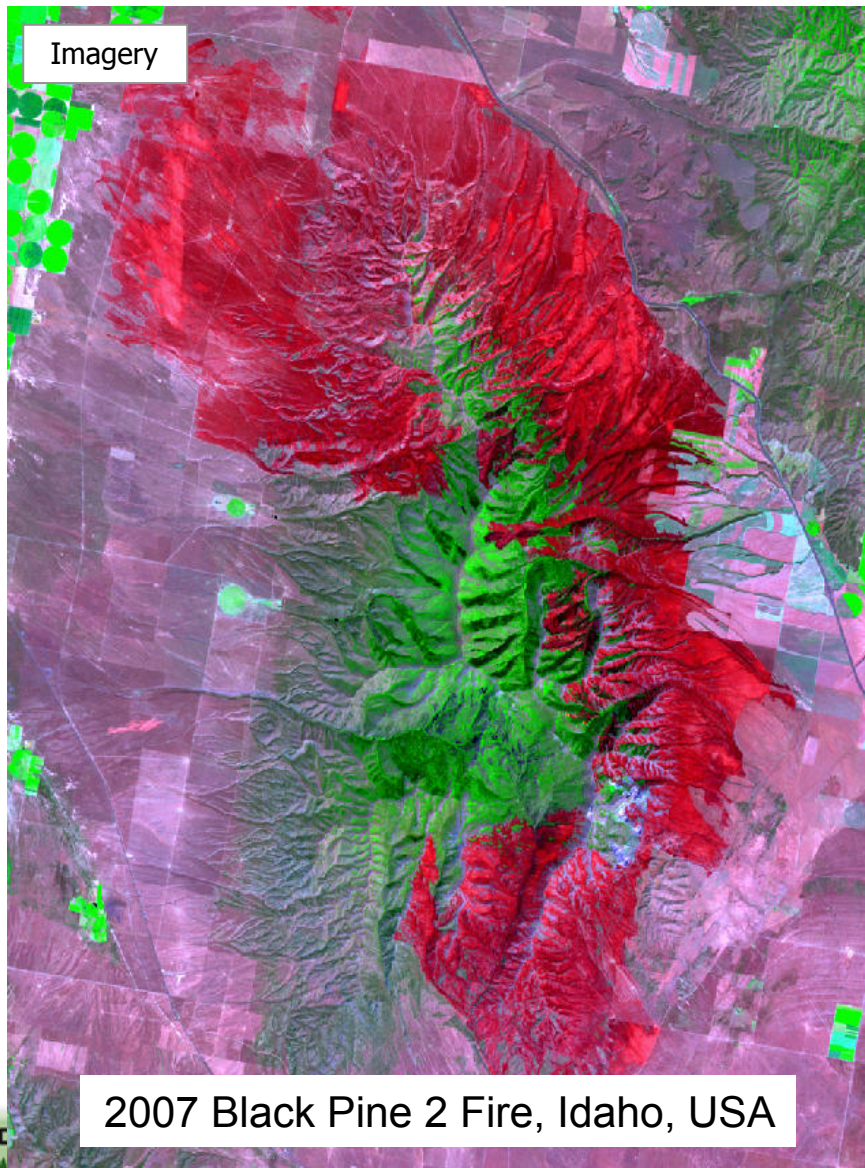
CBI



Water repellency

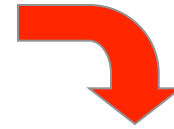
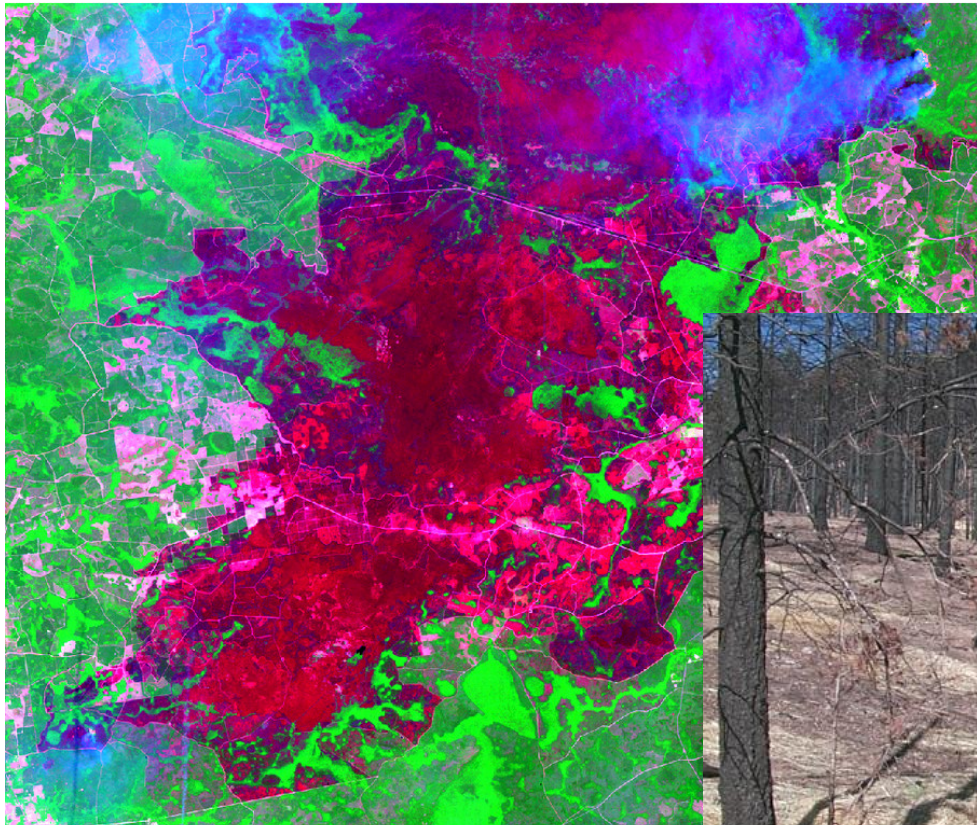


Satellite Perspective



Connecting the Dots

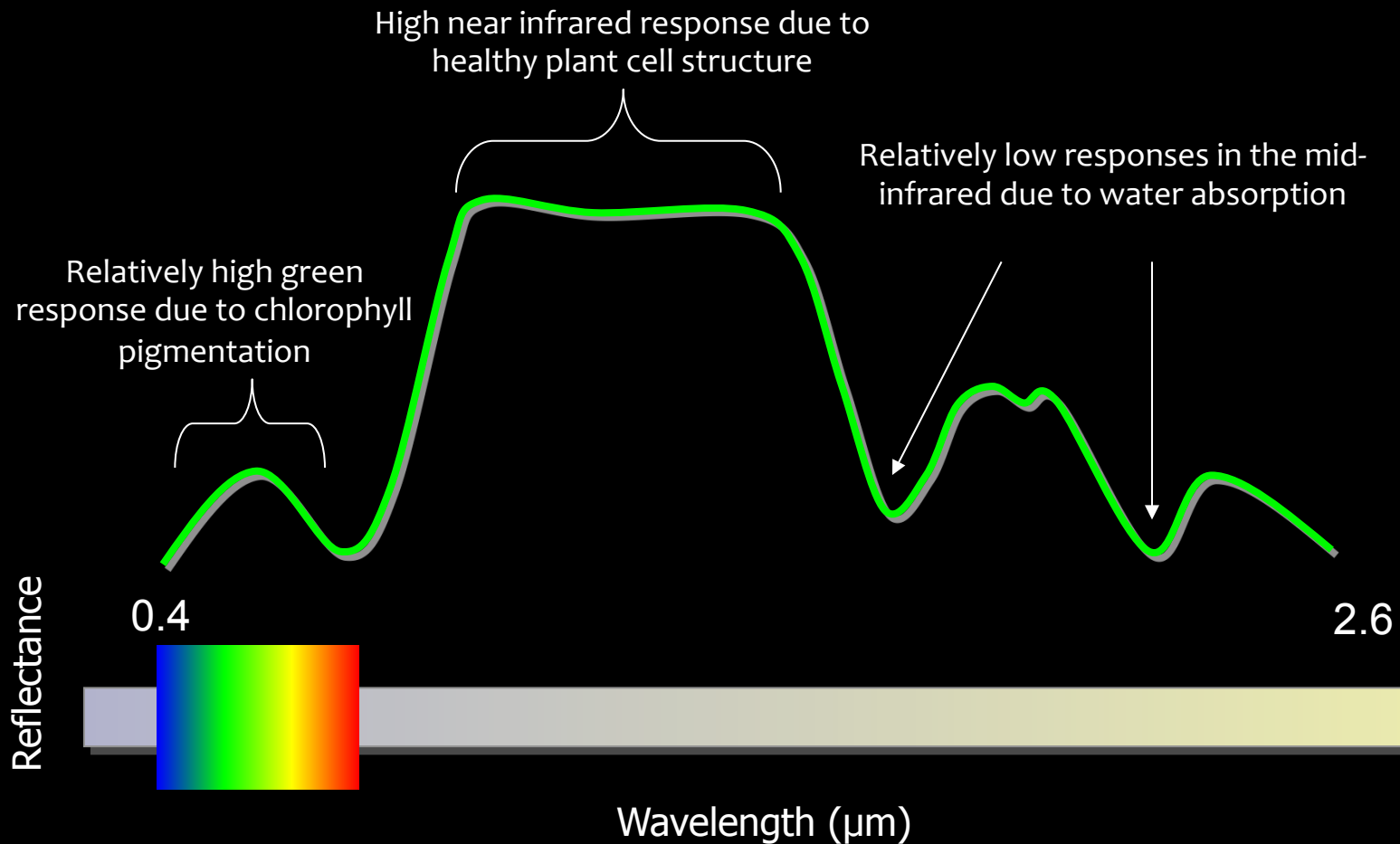
- How do we connect pixels in a satellite image to burn severity on the ground?



4/28/2003

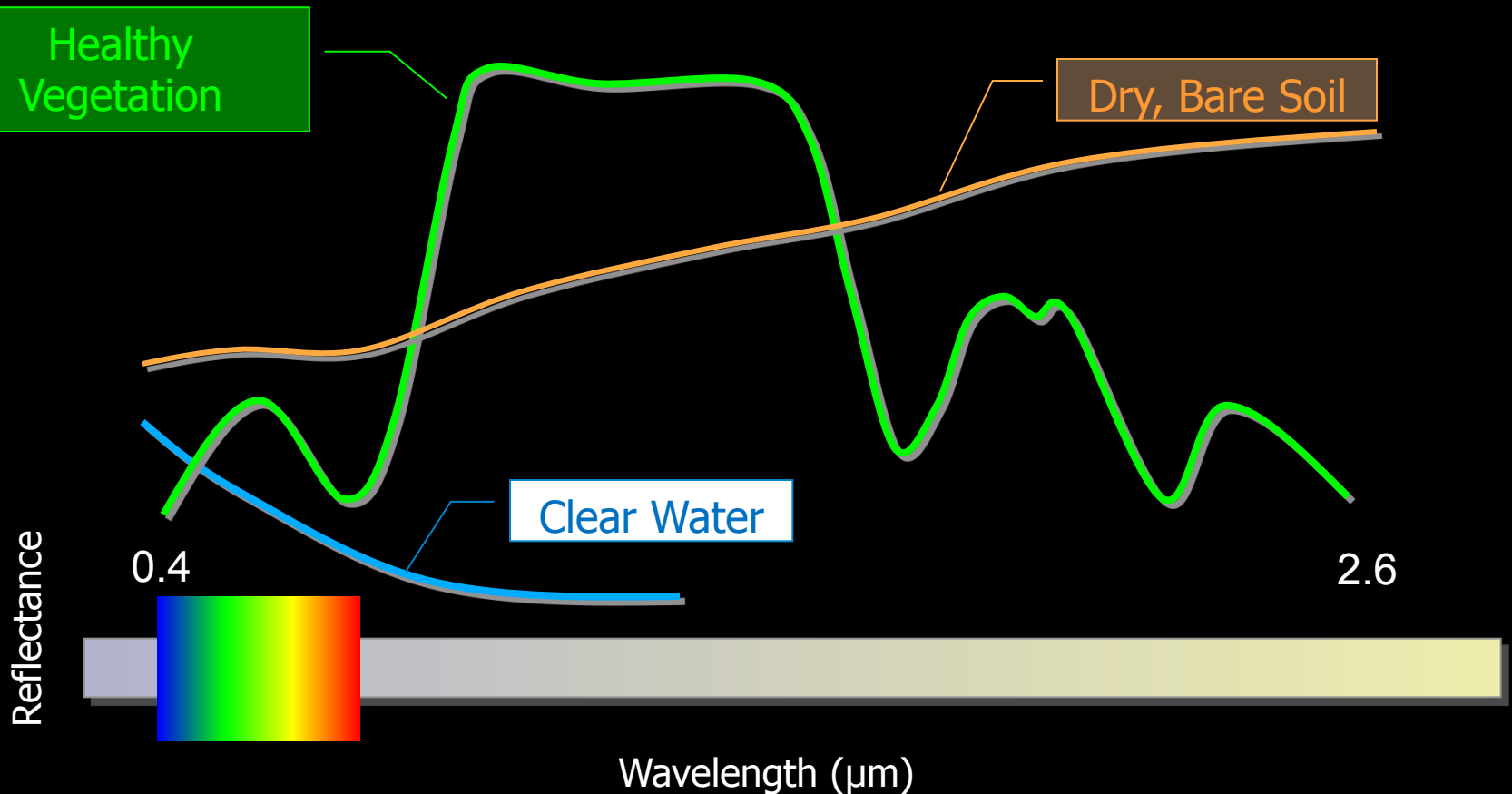
Response to EM Energy

Spectral response curve of typical vegetation from 0.4 to 2.6 μm



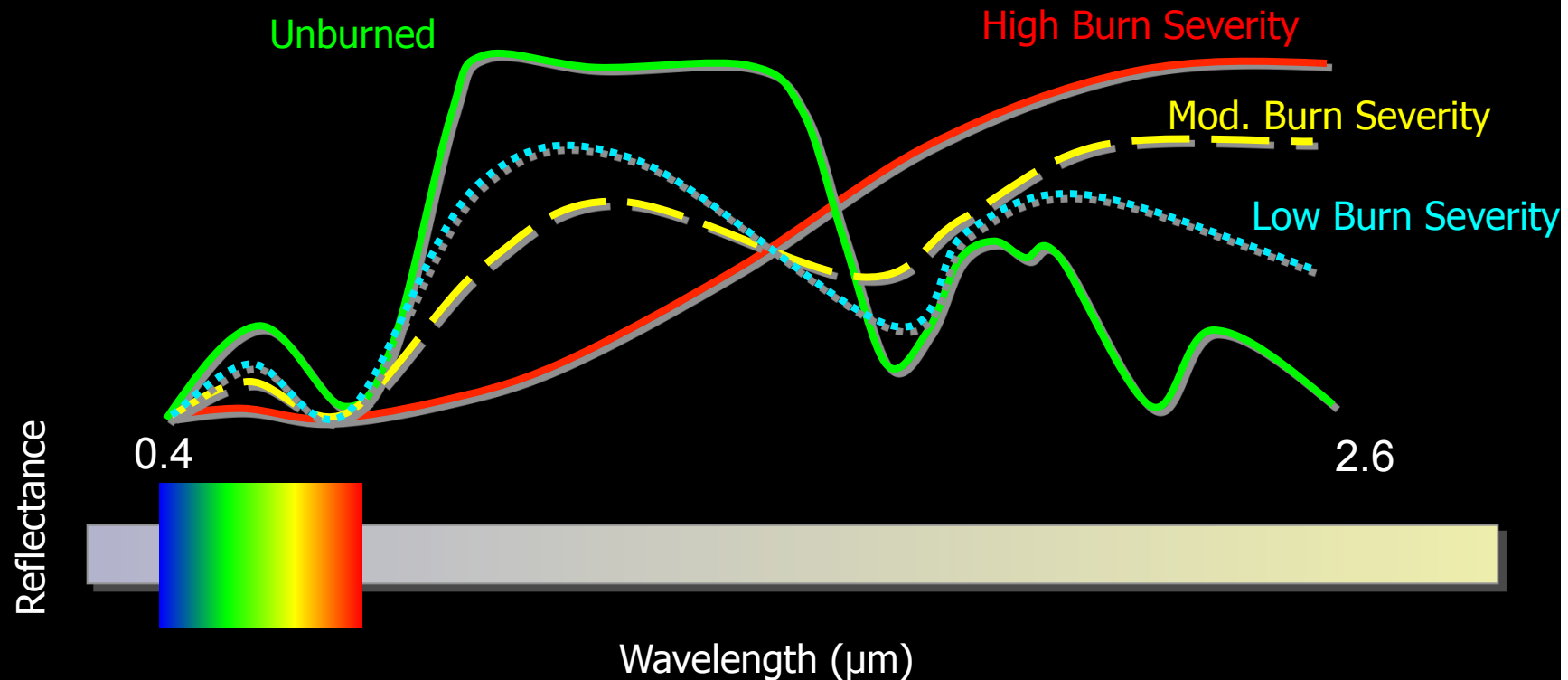
Typical Spectral Signatures

Typical Spectral Response Curves in the 0.4 to 2.6 μm Region...



Healthy Vegetation vs. Burned Areas

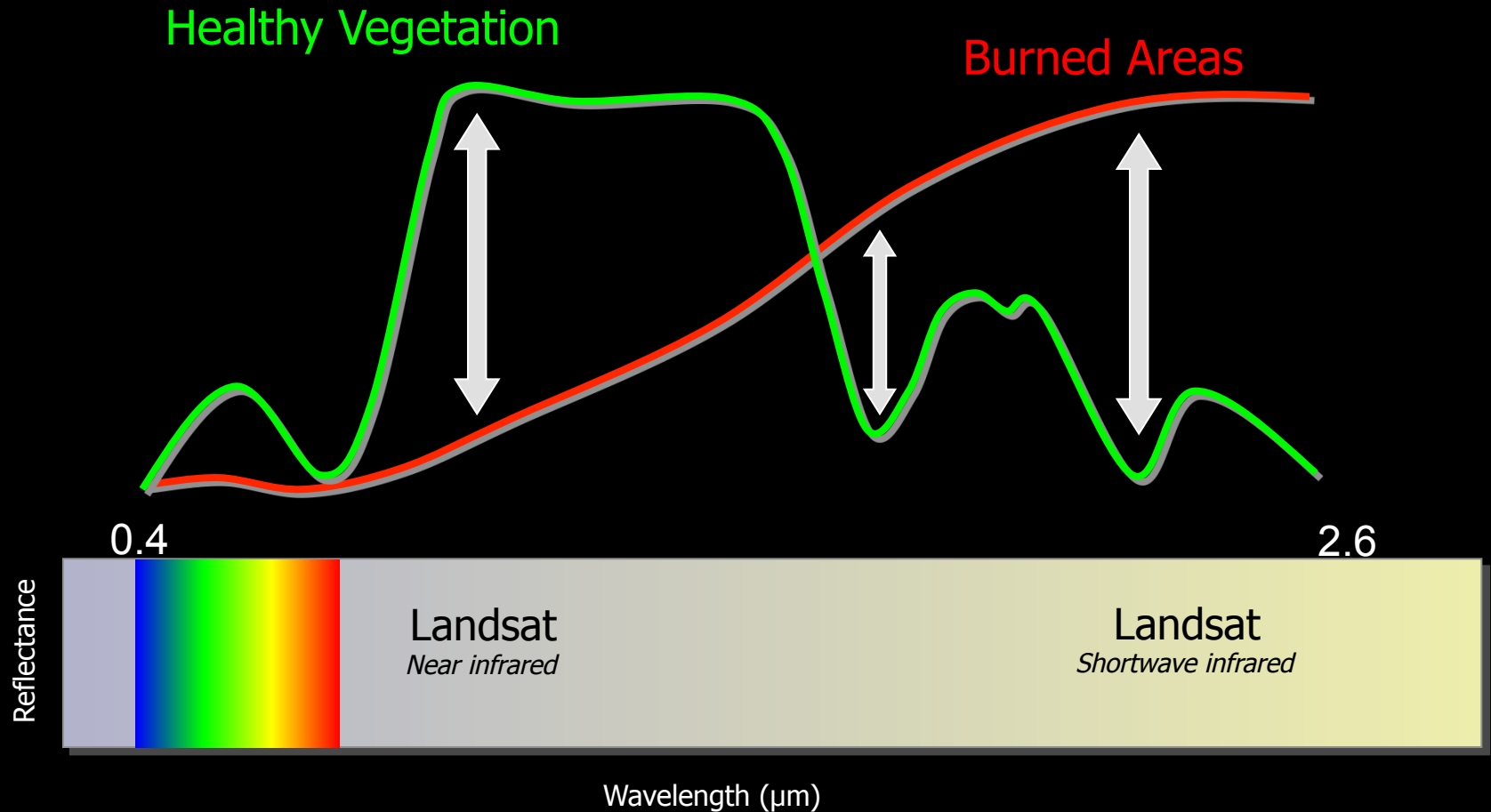
Exploiting Spectral Response Curves



The goal of remote sensing is to take advantage of differences in spectral response curves to distinguish one thing from another.

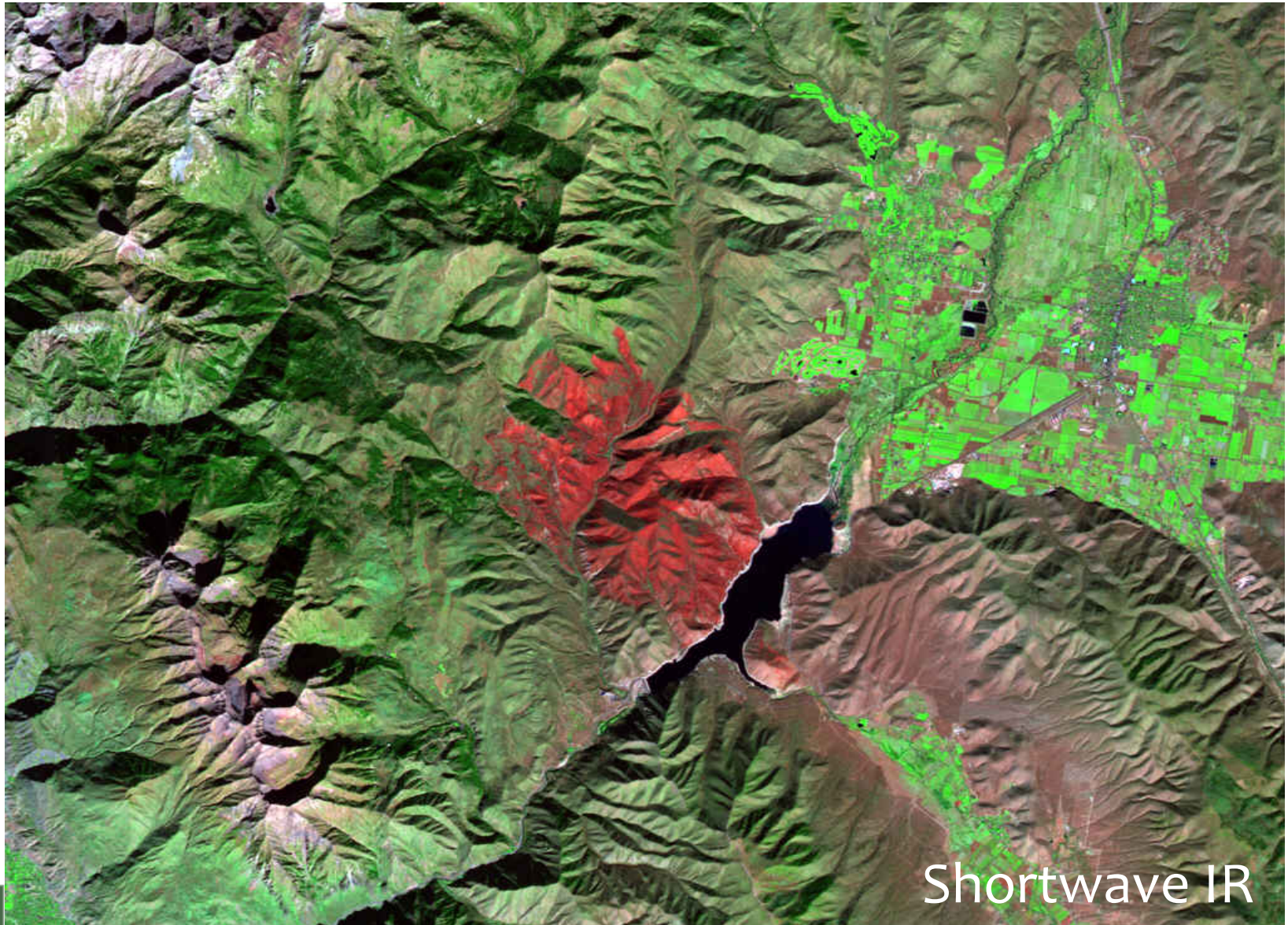
Healthy Vegetation vs. Burned Areas

Exploiting Spectral Response Curves



2003 Cascade II Fire
Utah, USA

Where's the wildfire?



Shortwave IR

Burned Area Emergency Response (BAER)

- Forest Service/DOI fast track emergency assessment
 - Range from 100s of acres to 100s of thousands of acres in size
- Assess fire effects on the soil and watershed hydrologic function (erosion and flood potential)
- Prescribe and implement emergency stabilization measures to mitigate potential hazards to:
 - Life
 - Property
 - Long-term soil productivity
 - Water quality
 - Natural resources
- BAER response plan is required within 7 days of fire containment



Remote Sensing in Support of the BAER Process

- Potential areas of impaired soil hydrologic function and other hazards are identified via change detection methods using satellite imagery
- Remote sensing products used by BAER teams to focus necessary field verification and analysis to areas of concern
 - Minimizes field time
 - Increases BAER team safety
- Facilitates rapid development of a geospatial soil burn severity product by BAER team
 - Improved product compared to previous methods
 - Used in analysis/modeling to determine necessary BAER treatments
- RSAC provides support to USFS BAER teams; EROS supports DOI BAER teams
 - Consistent products for all agencies
 - Support provided since 2001



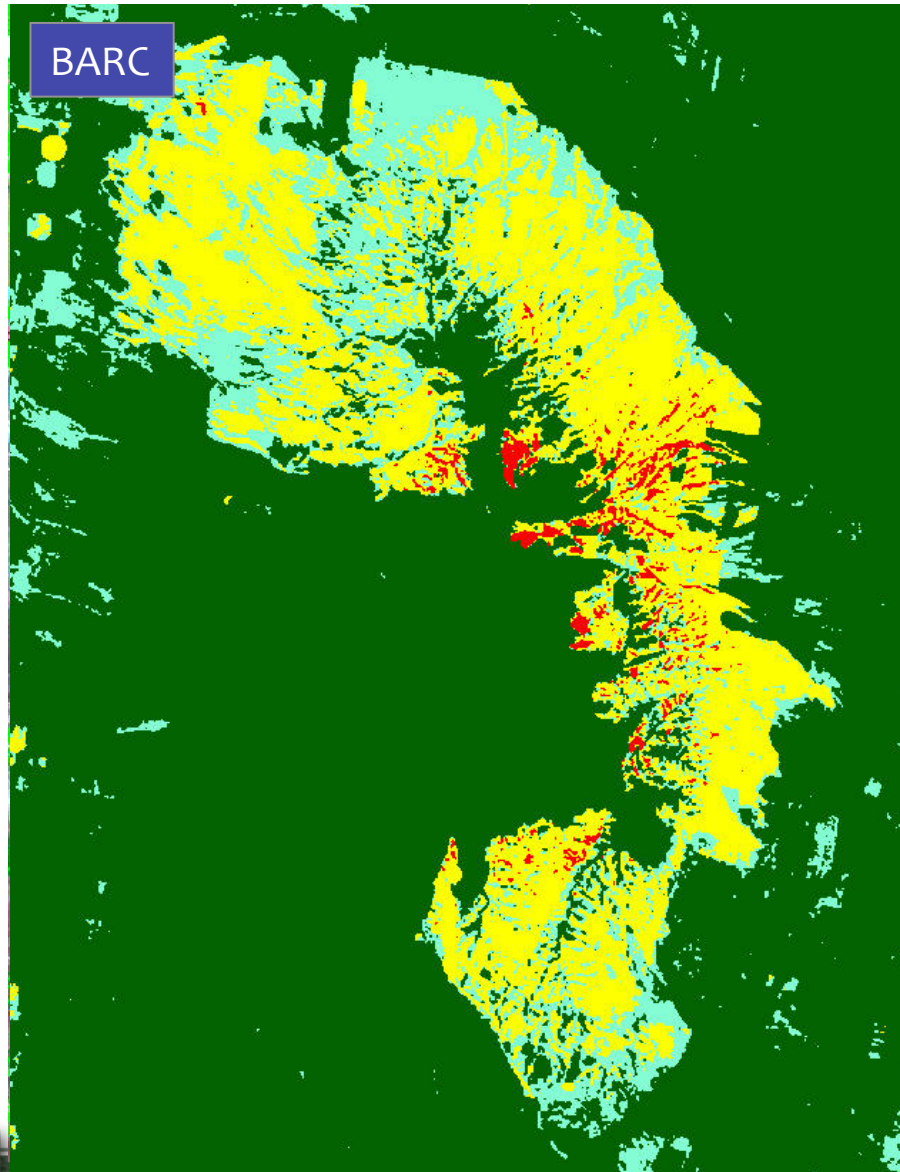
2015 BAER Imagery Support Program

Sensors

Sensor	Spatial Resolution	Temporal Resolution (days)	Analysis	Source
Landsat 8 OLI	30m	16	dNBR	USGS EROS
Landsat 7 ETM+	30m	16	dNBR	USGS EROS
EO-1 ALI	30m	16 (Targetable)	dNBR	NASA Goddard Space Flight Center/USGS EROS
DEIMOS-1 and UK DMC	22m	10-20	dNDVI	USDA Foreign Agriculture Service - Satellite Image Archive
SPOT 5	10m/20m	11 (Targetable)	dNDVI	USGS EROS/Hazard Data Distribution System



Creating the BARC



Black Pine 2 Fire
Sawtooth NF
73,000 Acres

Normalized Burn Ratio (NBR)
Differenced Normalized Burn Ratio (dNBR)

$$\text{NBR} = (\text{NIR} - \text{SWIR}) / (\text{NIR} + \text{SWIR})$$

$$\text{dNBR} = \text{Pre NBR} - \text{Post NBR}$$

BARC
(Burned Area Reflectance Classification)

- simplified dNBR

Data Processing

Image processing method depends on which sensor is used...

NBR

(Normalized Burn Ratio)

$$\text{NBR} = (\text{NIR} - \text{SWIR}) / (\text{NIR} + \text{SWIR})$$

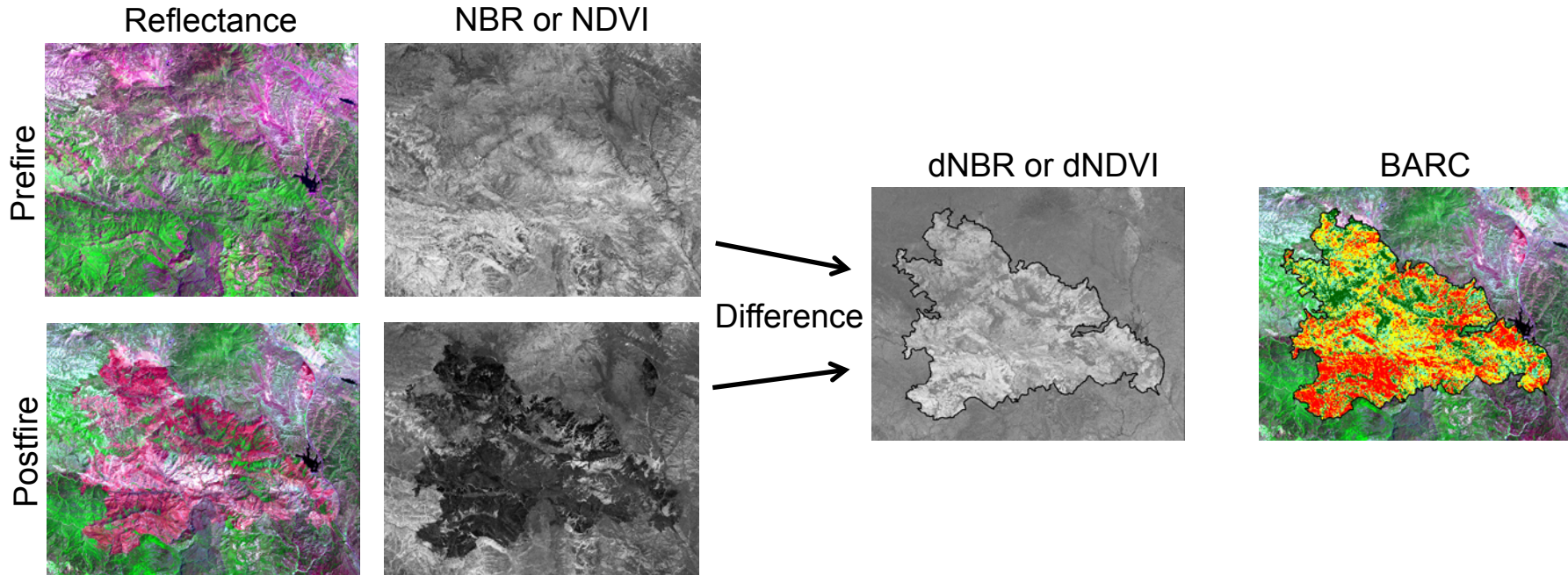
$$\text{dNBR} = \text{Prefire NBR} - \text{Postfire NBR}$$

NDVI

(Normalized Difference Vegetation Index)

$$\text{NDVI} = (\text{NIR} - \text{RED}) / (\text{NIR} + \text{RED})$$

$$\text{dNDVI} = \text{Prefire NDVI} - \text{Postfire NDVI}$$



International Postfire Mapping Support

- RSAC has provided imagery and BARC data to the following countries for post-wildfire support...
 - Canada
 - Greece
 - Australia



Contacts and Tech Support

Training is available for all interagency BARC users
For help and information please contact:

US Forest Service:	Department of Interior:
Carl Albury	Randy McKinley
calbury@fs.fed.us	rmckinley@usgs.gov
(801) 975-3351	(605) 594-2745

Order BAER Imagery:
[BAER Imagery Request Website](http://svinetfc6.fs.fed.us/birch/)
(<http://svinetfc6.fs.fed.us/birch/>)

For additional information please visit the RSAC BAER website:
[RSAC - BAER Website](http://fsweb.rsac.fs.fed.us)





Guest Speaker: Keith Weber

RECOVER DSS

NASA RECOVER

ARSET Remote Sensing for Wildfire
Applications webinar



What is RECOVER?

- RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery
- NASA Applied Sciences Program sponsored project



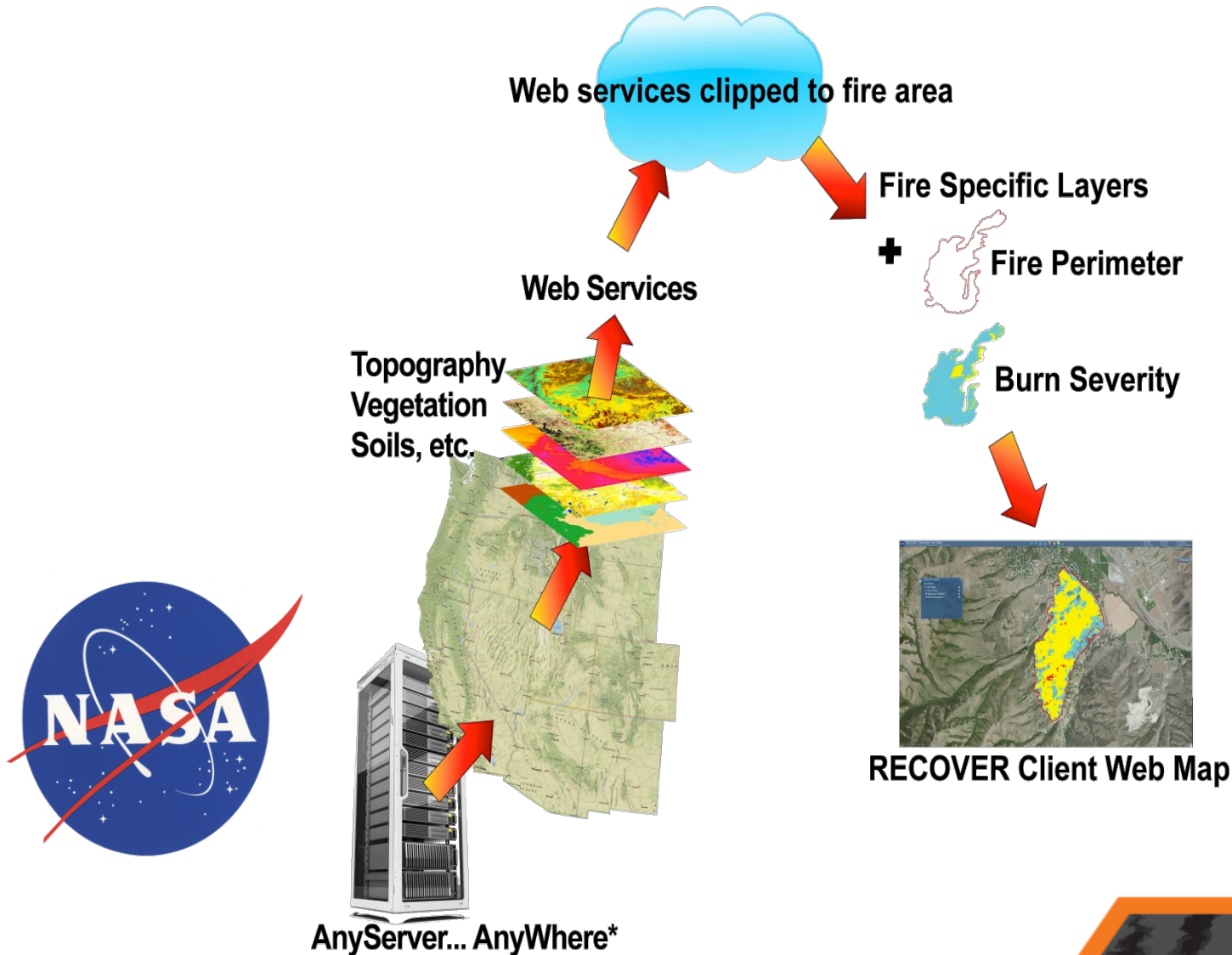
What is RECOVER?

- Customer-driven, Customer-centric*
- Decision Support System (DSS)
 - Rapid assembly of site-specific data
 - Delivered in customized GIS analysis environment
 - Wildfire focus



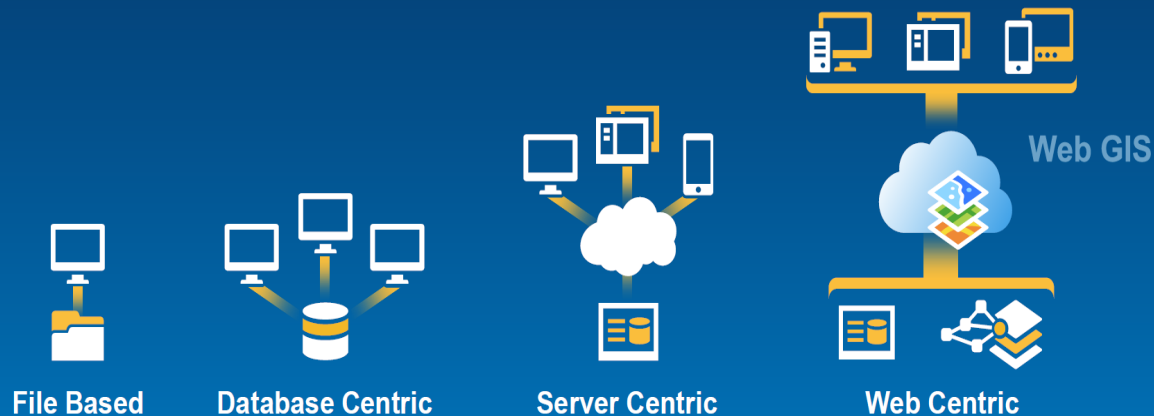
* Our “customer” is the USDI BLM, Idaho Dept. of Lands, and other wildfire management agencies (National Park Service, USFS, etc.)

How Does it Work?

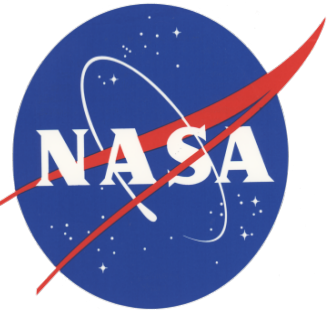


Benefits of RECOVER

Leveraging Common Computing Architecture



- Works seamlessly across all devices
- Reduces need for custom applications
- Platform for integration with other business systems
- Cross organizational collaboration
- Ready to use content and services
- Content management system



Live Demo

RECOVER:

[http://giscenter.isu.edu/research/Techpgg/
nasa_RECOVER/index.htm](http://giscenter.isu.edu/research/Techpgg/nasa_RECOVER/index.htm)



Coming up next week!

**Week 3: New techniques and
technologies**

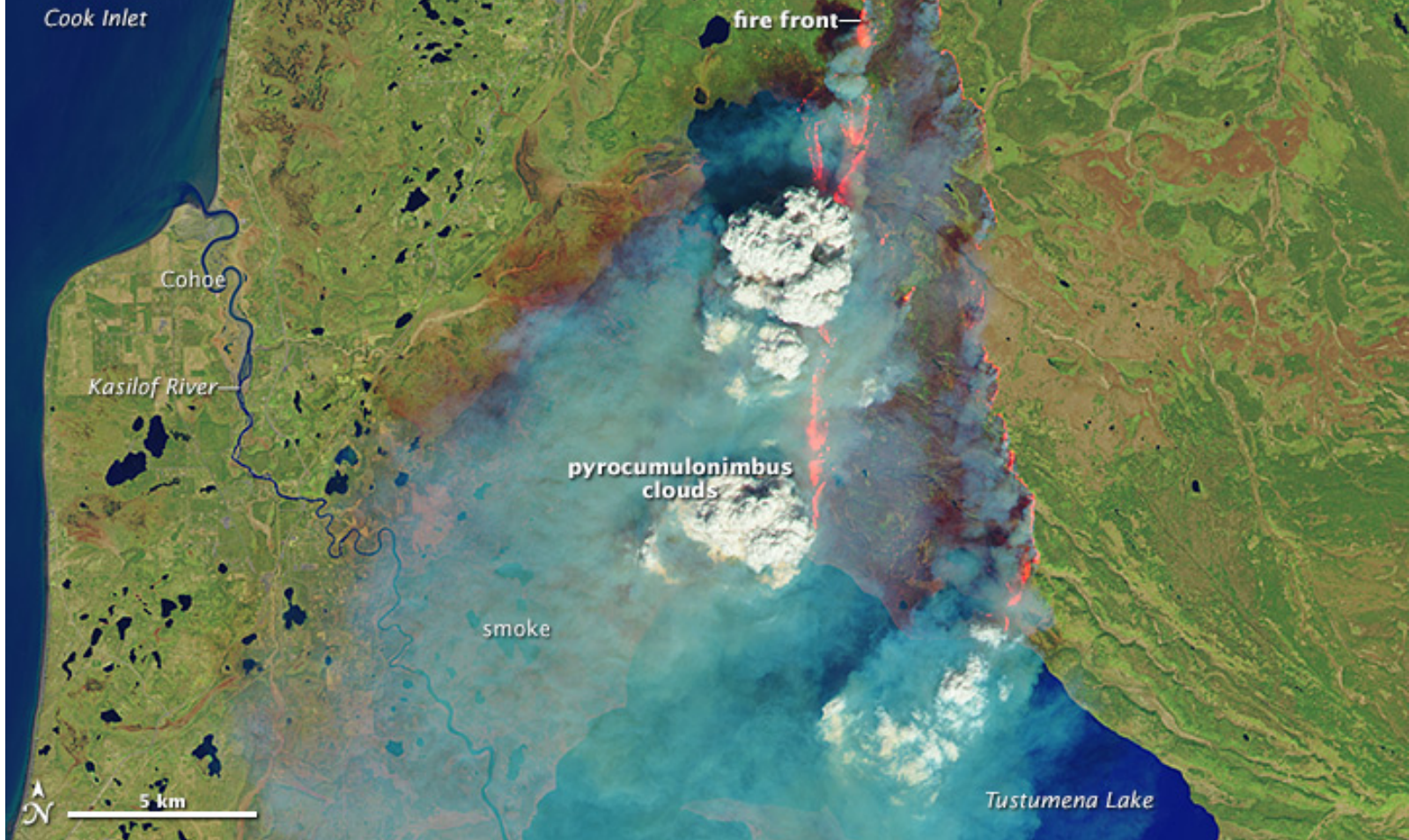


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False color
Landsat 8
image of the
Funny River
Fire in
southern
Alaska.

May 20,
2014



Thank You!!

Cindy Schmidt
Cynthia.L.Schmidt@nasa.gov